

User Manual
LaserCam™-HR-InGaAs
Beam Diagnostics Digital InGaAs Camera
USB 2.0



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Beam Diagnostics Digital
InGaAs Camera
USB 2.0



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Wilsonville, OR 97070

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Technical Support

In the U.S.:

Should you experience difficulties with your product, or need technical information, please visit our website: www.Coherent.com. You can obtain additional support by either telephoning our Technical Support Hotline at 1.800.343.4912, or e-mailing our Support Team at support.instruments@Coherent.com. Telephone coverage is available Monday through Friday (except U.S. holidays).

If you call outside our office hours, your call will be taken by our answering system and will be returned when the office reopens.

If there are technical difficulties with your product that cannot be resolved by support mechanisms outlined above, please e-mail or telephone Coherent Technical Support with a description of the problem and the corrective steps attempted. When communicating with our Technical Support Department, via the web or telephone, the model and serial number of the product will be required by the Support Engineer responding to your request.

Outside the U.S.:

If you are located outside the U.S., visit our website for technical assistance, or telephone our local Service Representative. Representative phone numbers and addresses can be found on the Coherent website: www.Coherent.com.

Coherent provides web and telephone technical assistance as a service to its customers and assumes no liability thereby for any injury or damage that may occur contemporaneous with such services. These support services do not, under any circumstances, affect the terms of any warranty agreement between Coherent and the buyer. Operating a Coherent product with any of its interlocks defeated is always at the operator's risk.

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Preface

This manual contains user information for the LaserCam™-HR-InGaAs Beam Diagnostics Digital Uncooled InGaAs camera.

RoHS Compliance

This Coherent product was released as RoHS-compliant. If you purchased your product prior to 11/2006, contact Coherent Technical Support to determine the appropriate part numbers for your product. You can locate the date of manufacturing for your product on the serial number label.

U.S. Export Control Laws Compliance

It is the policy of Coherent to comply strictly with U.S. export control laws.

Export and re-export of lasers manufactured by Coherent are subject to U.S. Export Administration Regulations, which are administered by the Commerce Department. In addition, shipments of certain components are regulated by the State Department under the International Traffic in Arms Regulations.

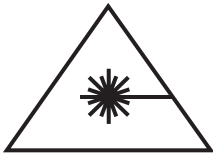
The applicable restrictions vary depending on the specific product involved and its destination. In some cases, U.S. law requires that U.S. Government approval be obtained prior to resale, export or re-export of certain articles. When there is uncertainty about the obligations imposed by U.S. law, clarification should be obtained from Coherent or an appropriate U.S. Government agency.

Publication Updates

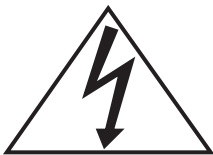
To view information that may have been added or changed since this publication went to print:

1. Connect to www.Coherent.com.
2. Type **LaserCam-HR-InGaAs** in the Site Search box (top left of the screen) and then click the “>>” button.

Symbols Used in This Document



This symbol is intended to alert the operator to the presence of exposure to hazardous visible and invisible laser radiation.



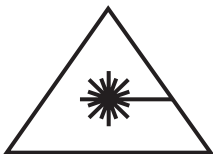
This symbol is intended to alert the operator to the presence of dangerous voltages associated with the product that may be of sufficient magnitude to constitute a risk of electrical shock.



This symbol is intended to alert the operator to the presence of important operating and maintenance instructions.

SAFETY

Carefully review the following safety information to avoid personal injury and to prevent damage to this instrument or any sensor connected to it. This equipment contains no user-serviceable parts. For service information, refer to “Obtaining Service” on page 26.



The use and measuring of lasers is potentially dangerous. This instrument operates over wavelengths that include non-visible laser emissions.

Proper laser operating practice in accordance with manufacturer recommendations is vital.

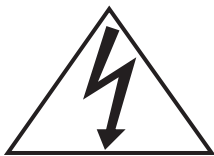
Eyewear and other personal protective equipment must be used in accordance with applicable laws and regulations.

If in doubt of correct operating procedures, consult the laser manufacturer and your laser safety officer.

The equipment is not for use in critical medical environments.



Do not operate the camera if its panels are removed or any of the interior circuitry is exposed.



Do not operate the camera in wet or damp conditions, or in an explosive atmosphere.



Operate the camera only within the specified voltage range.



Do not operate the camera if there are suspected failures. Refer damaged equipment to qualified Coherent service personnel.

Waste Electrical and Electronic Equipment (WEEE, 2002)

The European Waste Electrical and Electronic Equipment (WEEE) Directive (2002/96/EC) is represented by a crossed-out garbage container label (see Figure 1, below). The purpose of this directive is to minimize the disposal of WEEE as unsorted municipal waste and to facilitate its separate collection.

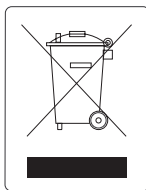


Figure 1. Waste Electrical and Electronic Equipment Label

DESCRIPTION

The LaserCam™-HR-InGaAs Beam Diagnostics Digital Uncooled InGaAs camera utilizes a large area progressive scan sensor for detection and analysis of laser beam profiles from 500 μm to 6.0 mm in diameter with 30 μm by 30 μm spatial resolution over the spectral range of 900 to 1700 nm. LaserCam-HR-InGaAs characteristics include excellent signal-to-noise ratio and linear response for accurate beam dimension and uniformity measurements, and high overexposure protection for distortion-less measurements of saturated beam profiles. Other features include:

- USB 2.0 digital interface
- Compact design minimizes space required in optical train
- Uses a single USB high-speed interface cable for data and power
- A Low Distortion Faceplate (LDFP) that minimizes room light, protects the CMOS array, and provides laser grade quality attenuation of 2500:1
- High sensitivity and dynamic range
- No lag, geometric distortion, or image burn-in
- Accepts C-mount optics, including all Coherent optical sampling and attenuation accessories.
- Large area 320 x 256 active picture elements (pixels)



- Requires only USB 2.0 connections
- CE compliant when used with a CE-compliant computer and cables

Parts and Accessories List

Table 1 lists the orderable parts for the LaserCam-HR-InGaAs system.

Table 1. Parts and Accessories List

ITEM	PART NUMBER
LaserCam-HR-InGaAs System (RoHS)	1149002
Low Distortion Face Plate (LDFP)	1127133
Trigger In and Pass/Fail Output Cable (RoHS)	1148592
USB Cable, 3.0 meters (RoHS)	1114614
LaserCam-HR-InGaAs Shipping Container	1073686
LaserCam-HR-InGaAs User Manual (this document)	1148416

GETTING STARTED

This section discusses the following topics:

- Unpacking (this page)
- Installing the software (page 6)
- Cabling (page 12)
- Mounting the camera (page 15)

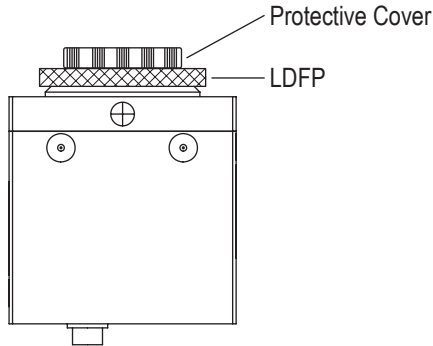
Unpacking

The LaserCam-HR-InGaAs is a digital, uncooled camera, designed for use with a USB 2.0 interface. The camera, trigger cable, and CD-ROM are shipped in a high-density plastic carrying case. This specially-designed case protects all items during shipment.

Visually check all cartons for damage before unpacking. If there is no visible external damage, remove all items from the cartons and inspect them for damage. Immediately advise Coherent of any damage. A Returned Material Authorization (RMA) will be issued for any damaged instruments (refer to the last page of this guide for contact information).



When inspecting a LaserCam-HR-InGaAs camera, remove only the protective cover, not the LDFP (Low Distortion Faceplate). See the following figure.



Installing the Software

This section explains how to install the software on the following operating systems:

- Windows XP™
- Windows Vista™ (32-bit)

These installation procedures are discussed, below.

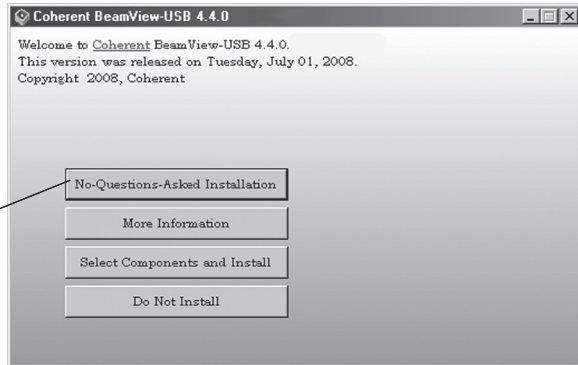
Windows XP

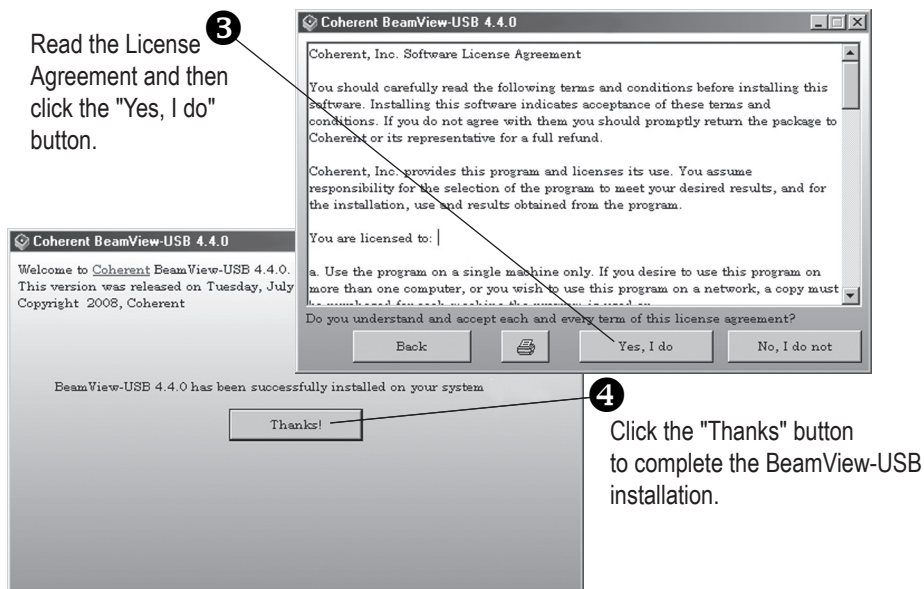


Do *not* connect a LaserCam-HR-InGaAs camera to a USB 2.0 PC port at this time. The software must be installed *before* physically connecting a camera to the computer.

- 1** Insert the BeamView-USB CD into your CD-ROM drive. If Autorun is enabled on your system, installation will start automatically; otherwise, select Run from the Start menu and then type **D:\Setup** (substitute the appropriate letter of your CD-ROM drive for **D**).

- 2** Click the "No-Questions-Asked Installation" button.

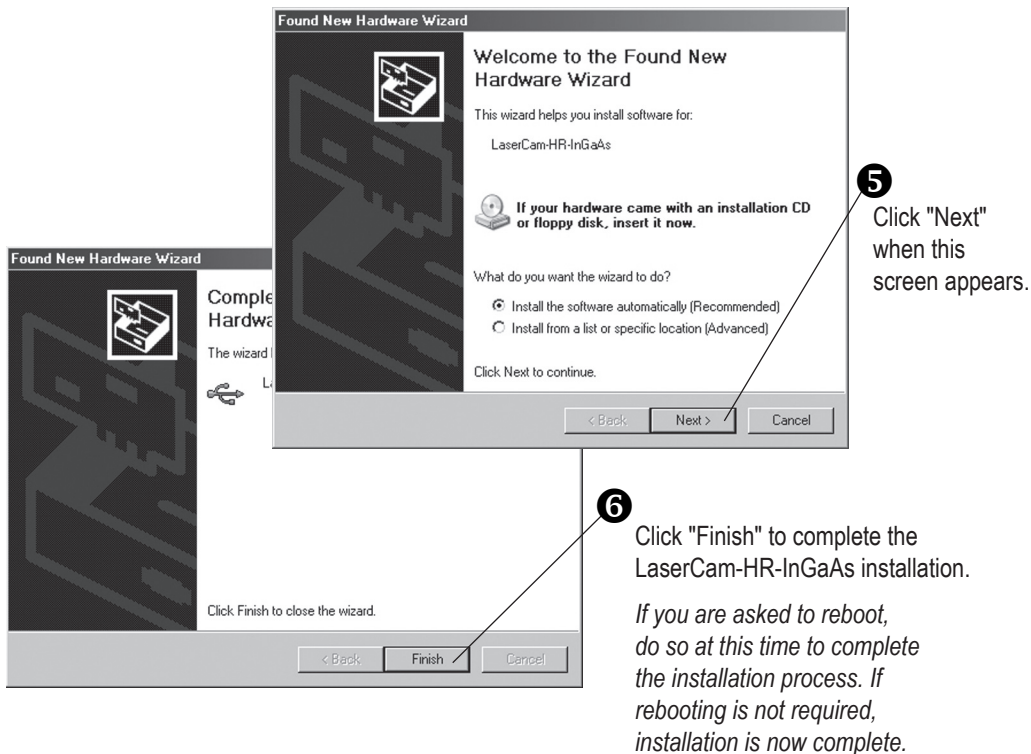




A shortcut to BeamView-USB will automatically be placed on the desktop. Do not click it at this time. Continue with the installation.



Connect a LaserCam-HR-InGaAs camera to the USB 2.0 PC port before continuing with the installation.



For information on getting started with LabVIEW for BeamView-USB 4.4.0, refer to the LV_BV AppNote.pdf file located on the Installation CD and in the BeamViewUSB folder.

Windows Vista (32-bit)

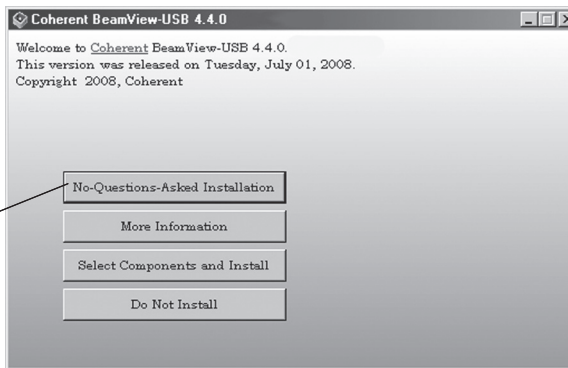


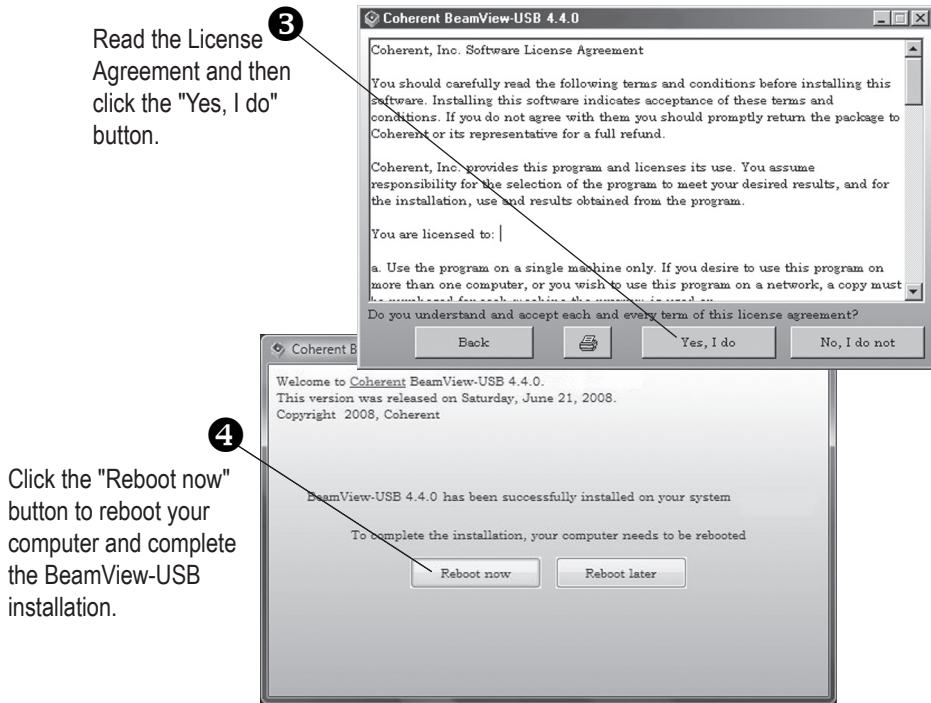
Do *not* connect a LaserCam-HR-InGaAs camera to a USB 2.0 PC port at this time. The software must be installed *before* physically connecting a camera to the computer.

- 1 Insert the BeamView-USB CD into your CD-ROM drive. If Autorun is enabled on your system, installation will start automatically; otherwise, select Run from the Start menu and then type **D:\Setup** (substitute the appropriate letter of your CD-ROM drive for **D**).

2

Click the "No-Questions-Asked Installation" button.





A shortcut to BeamView-USB will automatically be placed on the desktop. Do not click it at this time.

Once the computer has rebooted:

- Connect a LaserCam-HR-InGaAs camera to the USB 2.0 PC port.
- Double-click the BeamView-USB shortcut on the desktop. This action will start the BeamView-USB program and automatically install the camera.

The installation process is now complete.

For information on getting started with LabVIEW for BeamView-USB 4.4.0, refer to the LV_BV AppNote.pdf file located on the Installation CD and in the BeamViewUSB folder.

Cabling

Two cables are provided with the LaserCam-HR-InGaAs camera: USB and Trigger Input and Pass/Fail Output:

- The USB cable must be connected between the camera and the computer for proper operation.
- The Trigger Input and Pass/Fail Output cable provides for asynchronous pulsed laser beam capture or a TTL level Pass/Fail output signal. This cable is not required for CW (continuous) laser analysis or pulsed laser beam capture using BeamView in the autotrigger mode based on an intensity threshold.

These cables are explained in more detail, next.

USB Cable

Connect the USB 2.0 cable to the USB 2.0 connector on the LaserCam-HR-InGaAs camera (see Figure 2).

Do not connect the USB cable to the computer until instructed to do so.

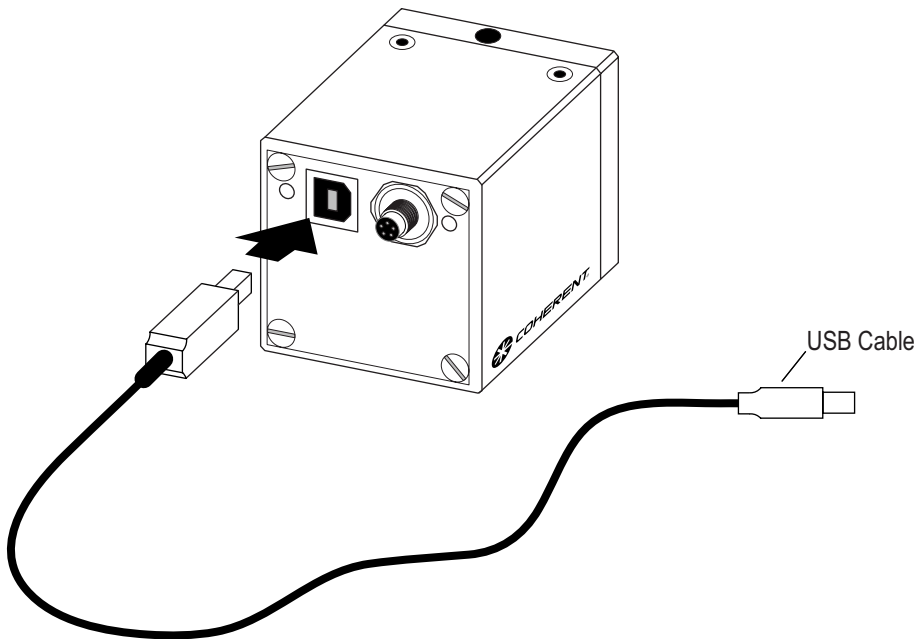


Figure 2. Connecting the USB Cable

LaserCam-HR-InGaAs produces a standard USB 2.0 digital signal. It will interface through the USB 2.0 connector of any compatible PC using Coherent Beam-View Version 4.4.x software.

Connecting the Trigger Input and Pass/Fail Output cable is discussed, next.

Trigger Input and Pass/Fail Output Cable

For detailed information about the Trigger Input and Pass/Fail Output cable (1148592) shown in Figure 3, refer to the BeamView-USB software Help file.

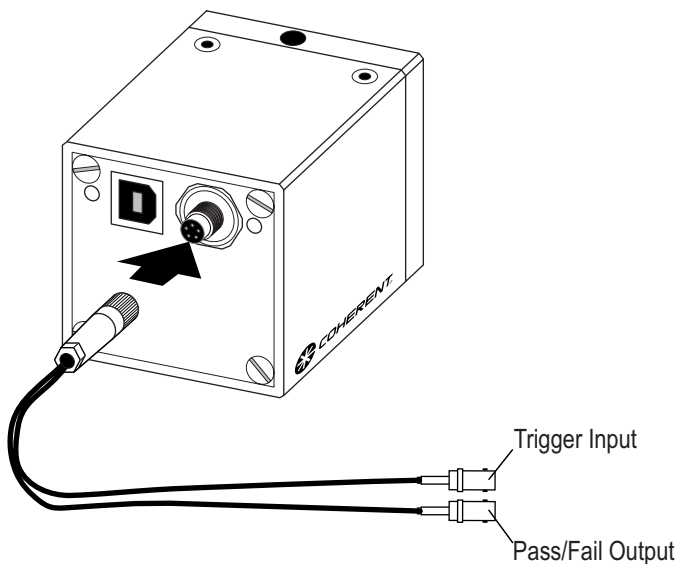


Figure 3. Connecting the Trigger Input and Pass/Fail Output Cable

Mounting the Camera

LaserCam-HR-InGaAs is designed to be mounted with a $\frac{1}{4}$ -20 or M6 threaded mounting post. Mounting post attachment locations are shown in Figure 4.

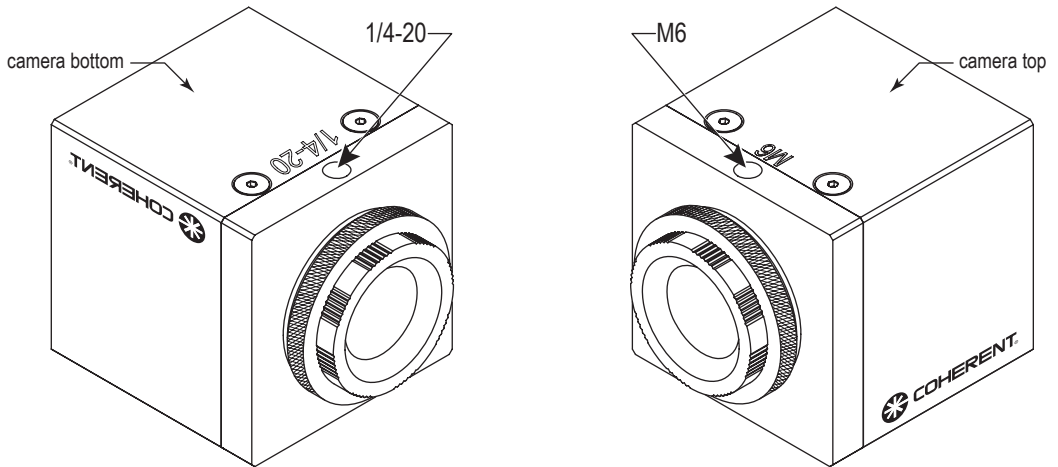


Figure 4. Mounting Post Attachment Locations

OPERATION

This section discusses the following topics:

- Pixel spacing (page 18)
- Power on (page 18)
- Warm-up time (page 18)
- Maximum power levels (page 19)
- Saturation (page 19)
- Trigger (page 19)
- Low Distortion Faceplate (LDFP) (page 20)
- Dust/dirt (page 20)
- Cleaning the sensor (page 21)
- Fringes (page 22)
- How to get the most from your camera system (page 23)

Pixel Spacing

The LaserCam-HR-InGaAs pixel spacing values are shown in Table 2.

Table 2. Pixel Spacing for LaserCam-HR-InGaAs

	LARGE AREA FORMAT	
	Horizontal Spacing	Vertical Spacing
LaserCam-HR-InGaAs	30 μm	30 μm

Power On

LaserCam-HR-InGaAs has no ON/OFF switch. As soon as power is applied to the camera via the USB 2.0 connection, it begins operating.

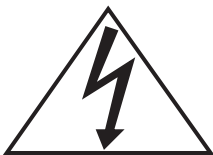
Warm-Up Time

The LaserCam-HR-InGaAs does not require warm-up. However, if it is used to make high-accuracy measurements, it should be allowed to warm-up at least 30 minutes to insure best baseline (background) stability.

For best results, the background map should be taken after the camera warm-up period.

Maximum Power Levels

The camera will saturate at approximately $50 \mu\text{W}/\text{cm}^2$ at 1064 nm wavelength, $30 \mu\text{W}/\text{cm}^2$ at 1523 nm wavelength, or $0.08 \mu\text{J}/\text{cm}^2$ pulsed 1064 nm wavelength.



Damage may occur at power levels that exceed 10,000 times saturation power density.

Saturation

Table 3. Saturation

WAVELENGTH	ON ARRAY	ON LDFP
1064 nm (CW)	$50 \mu\text{W}/\text{cm}^2$	$3.5 \text{ mW}/\text{cm}^2$
1064 nm (Pulse)	$0.08 \mu\text{J}/\text{cm}^2$	$5 \mu\text{J}/\text{cm}^2$
1523 nm (CW)	$30 \mu\text{W}/\text{cm}^2$	$350 \mu\text{W}/\text{cm}^2$

Trigger

The LaserCam-HR-InGaAs trigger permits the beam diagnostic system to interface with pulsed lasers and transient optical events, including single shot lasers.

Trigger In

Trigger In uses the BNC connector labeled “TRIG IN” on the LaserCam-HR-InGaAs Trigger and Pass/Fail cable. This 5 VDC, TTL input—which is available on the rising or falling edge—causes the camera to immediately reset and begin integrating light. The Trigger In

delay is 19 μ S. This is the time it takes for the camera to begin integrating light once the trigger signal occurs. The LaserCam-HR-InGaAs is capable of capturing laser pulse repetition rates of up to 500 Hz without averaging adjacent pulses.

Low Distortion Faceplate (LDFP)

The Low Distortion Faceplate provides a protective window for the camera array that also acts as a background attenuator with 0.04% to 0.05% typical. The LDFP is made of laser grade filter glass that minimizes interference fringes (refer to “Fringes” on page 22) and does not distort the beam image. The LDFP limits room light, instrumentation lights, and flash lamp light from reaching the camera sensor. These lights cause a background level that may not be effectively subtracted by the Background Subtraction Wizard.

Dust/Dirt

If low intensity spots or small circles are noticed in the camera video then dust may be present on the InGaAs sensor or on the Low Distortion Faceplate (see Figure 5). Dust on the LDFP filter glass can cause distortion in the form of small circular diffraction rings, or can cause low-intensity spots if present on the sensor array. Observe the defects with a flashlight or a small light illuminating the camera. If the defect moves when the illumination angle is changed, then the dust is on the LDFP. Otherwise it is dust on the sensor array. Use clean air at low pressure, or methanol and lens tissue to clean the

LDFP filter glass. Take all necessary precautions to insure that nothing comes in contact with the sensor surface.

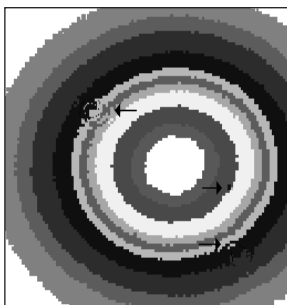


Figure 5. Dust on Filter Glass

Cleaning the Sensor

Avoid unnecessary exposure of the sensor to dust and dirt. If the surface of the sensor has to be cleaned, *never* use any kind of cloth, tissue, or brush, and strictly avoid the use of any kind of cleaning fluid. Only use clean, dry, micro-filtered low-pressure air to gently blow away particles from the surface of the sensor. Contact Coherent Customer Service if the sensor requires additional cleaning (refer to Table 4, “Coherent Service Centers,” on page 27 for contact information).



Touching the sensor will cause irreversible damage.



Always cover the sensor with a dust cap when not in use.

Fringes

If the LDFP filter glass is installed in the camera, fringes may appear in the video (see Figure 6). The fringe pattern is due to a second reflection off the sensor and LDFP superimposing back onto the original beam image. This situation can be corrected by loosening the C-mount setscrew and rotating the LDFP housing until the fringes are no longer present. Slightly turning the camera with respect to the laser beam may also reduce this effect.

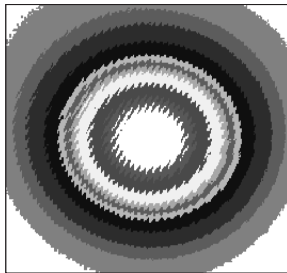


Figure 6. Fringes

How to Get the Most From Your Camera System

The LaserCam-HR-InGaAs camera has been carefully designed to provide accurate measurements of the spatial and intensity characteristics of laser beams. Significant attention has been paid to every aspect of the instrument that impacts data accuracy. The following items will help you obtain the best performance from your LaserCam-HR-InGaAs:

- System tray—Turn off everything that is non-essential to the running of the computer. This action will help assure the fastest frame update rate possible.
- RAM—A minimum of 512 MB is required. 1 GB is recommended. More is typically better.
- Select RAM for the buffer to obtain the highest update rates.
- Processor speed—A minimum of 2.1 GHz is recommended. Faster clock speeds provide higher frame update rates. Again, “the faster the better.”
- Keep all optics clean—Dirty LDFP, beam sampling, and attenuation optics will distort the beam under test. It is important that you regularly check these optical surfaces for dust, fingerprints, and other contamination. Follow standard coated optical surfaces cleaning techniques. Use the Inclusion command to reduce the size and amount of data that is processed.
- The Inclusion command provides control of the sensor area where calculations are performed. Reducing this area can significantly increase frame update rates and is especially effective with small spot sizes.



Cleaning the sensor surface will void the warranty and most likely will damage the camera.

It is strongly recommended that the LDSP always be left in place and that the dust cap be used to protect the LDSP when the instrument is not in use.

- Read the user documentation—The LaserCam-HR-InGaAs camera is a complex piece of optical test equipment. Many functions are included in the system that may not be obvious to a casual or first-time user. Review the *LaserCam-HR-InGaAs User Manual* (this manual) and the BeamView-USB Help (accessed by clicking the Help button in the BeamView software) to learn about these useful functions. Many calculations and functions that may at first appear to require post-processing or exporting of the data to another application are included in the instrument. The user documentation is designed to explain all of the functions in an easy-to-use format.



Observe standard Laser Safety procedures—The eyes you save may be your own.

WARRANTY

This section includes information on the following topics:

- Limited warranty (this page)
- Warranty limitations (page 26)
- Obtaining service (page 26)
- Product shipping instructions (page 28)

Limited Warranty

Coherent, Inc. (the “Company”) warrants its laser beam diagnostic products (“Products”) to the original purchaser (the “Customer”) that the product is free from defects in materials and workmanship and complies with all specifications, active at the time of purchase, for a period of twelve (12) months.

If the Product fails and is returned to the Company within one year following the date of purchase, the Company will, at its option, repair or replace the Product or any component found to be defective. This warranty applies only to the original purchaser and is not transferable.

Coherent, Inc. will, at its option, repair or replace any product or component found to be defective during the warranty period. This warranty applies only to the original purchaser and is not transferable.

Warranty Limitations

The foregoing warranties shall not apply, and Coherent reserves the right to refuse warranty service, should malfunction or failure result from:

- Damage caused by improper installation, handling, or use.
- Laser damage (including sensor elements damaged beyond repair).
- Failure to follow recommended maintenance procedures.
- Unauthorized product modification or repair.
- Operation outside the environmental specifications of the product.

Coherent assumes no liability for Customer-supplied material returned with Products for warranty service or recalibration.

THIS WARRANTY IS EXCLUSIVE IN LIEU OF ALL OTHER WARRANTIES WHETHER WRITTEN, ORAL, OR IMPLIED. COHERENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL THE COMPANY BE LIABLE FOR ANY INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS PRODUCTS.

Obtaining Service

In order to obtain service under this warranty, Customer must notify the Company of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. The Company

shall, in its sole discretion, determine whether to perform warranty service at the Customer's facility, at the Company's facility or at an authorized repair station.

If Customer is directed by the Company to ship the product to the Company or a repair station, Customer shall package the product (to protect from damage during shipping) and ship it to the address specified by the Company, shipping prepaid. The Company shall pay the cost of shipping the Product back to the Customer in conjunction with product failures within the first twelve months of time of sale.

A Returned Material Authorization number (RMA) assigned by the Company must be included on the outside of all shipping packages and containers. Items returned without an RMA number are subject to return to the sender.

For the latest Customer Service information, refer to our website: www.Coherent.com.

Detailed instructions on how to prepare a product for shipping are shown under "Product Shipping Instructions" on page 28.

Table 4. Coherent Service Centers

LOCATION	PHONE	FAX	E-MAIL
USA	1.800.343.4912	503.454.5777	info_service@Coherent.com
Europe	+49-6071-968-0	+49-6071-968-499	info_service@Coherent.com
International	503.454.5700	503.454.5777	info_service@Coherent.com

Product Shipping Instructions

To prepare the product for shipping to Coherent:

1. Contact Coherent Customer Service (refer to Table 4 on page 27) for a Return Material Authorization number.
2. Attach a tag to the product that includes the name and address of the owner, the person to contact, the serial number, and the RMA number you received from Coherent Customer Service.
3. Wrap the product with polyethylene sheeting or equivalent material.
4. If the original packing material and carton are not available, obtain a corrugated cardboard shipping carton with inside dimensions that are at least 6 in. (15 cm) taller, wider, and deeper than the product. The shipping carton must be constructed of cardboard with a minimum of 375 lb. (170 kg) test strength. Cushion the instrument in the shipping carton with packing material or urethane foam on all sides between the carton and the product. Allow 3 in. (7.5 cm) on all sides, top, and bottom.
5. Seal the shipping carton with shipping tape or an industrial stapler.
6. Ship the product to:
Coherent, Inc.
27650 SW 95th Ave.
Wilsonville, OR 97070
Attn: RMA # *(add the RMA number you received from Coherent Customer Service)*

APPENDIX A: SPECIFICATIONS

The following table lists specifications for the LaserCam-HR-InGaAs camera.

Table 5. Specifications (Sheet 1 of 3)

PARAMETER	DESCRIPTION
GENERAL	
Physical Dimensions	

Table 5. Specifications (Sheet 2 of 3)

PARAMETER	DESCRIPTION
Spectral Range	900 to 1700 nm
Camera Type	Uncooled InGaAs focal plane array
Video Format	14-bit digital USB 2.0 hi-speed
Sensor Active Area	9.6 mm (H) x 7.7 mm (V)
Sensor Elements	320 (H) x 256 (V)
Sensor Element Spacing	30 μm (H) x 30 μm (V)
Recommended Beam Diam.	0.5 mm min., 6.0 mm max. ($1/e^2$)
Optical Dynamic Range	> 1,000 to 1
Dimensional Accuracy	$\pm 2\%$ (typical), $\pm 5\%$ (over entire spectral and dimensional range)
Pulse Trigger In	TTL, rising or falling edge
Pulse Integration Timing	Integration begins 19 μs after rising edge of Trigger In
Automatic Pulse Trigger	0 to 100% of camera peak response (user adjustable)
Max. Sample Rate	25 Hz (Live mode), 15 Hz (Run mode)
Noise, Peak	5 nW/cm ² at room temperature
CW Saturation	3.5 mW/cm ² at 1.06 μm (with LDFP)
Pulsed Saturation	0.08 $\mu\text{J}/\text{cm}^2$ at 1.06 μm (with LDFP)
Damage Threshold	0.4 $\mu\text{J}/\text{cm}^2$ at 1.06 μm (without LDFP)
Distance to Image Plane	17.5 $\pm$ 0.5 mm (from front of LDFP)
Dimensions	50 x 50 x 68 mm
Weight	232 g (345 g with USB and Trig In cables)
Optical Mount	C-mount
Mounting	$1/4$ -20 and M6

Table 5. Specifications (Sheet 3 of 3)

PARAMETER	DESCRIPTION
I/O Connector	USB 2.0 Type B
ELECTRICAL	
Signal-to-Noise Ratio	> 69dB
Power	Powered through USB 2.0 interface
Power Consumption	< 4W
Video Output	Digital: USB 2.0
Black Level	Self-adjusting
Integration Time	Adjusted to 1 ms (user adjustable: 20 μ sec to 10 msec)
Synchronization	Internal free-running (crystal)
Gamma	1.0
Gain	No automatic gain control. Gain is factory set for optimum linear dynamic range.
ENVIRONMENTAL	
Operating Temperature	10 to 35°C
Relative Humidity	To 95% non-condensing

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Part No. 1148416, Rev. AB